Polar cells: **Basolateral** (bottom) + **Apical** (free surface)

Embryological Origin:

**Ectoderm** >> epidermis

**Endoderm** >> GI, resp, UG tract

**Mesoderm** >> internal cavity

2x types of Mesoderm:

**Mesothelium:** pericardial, pleural, peritoneal cavities

**Endothelium:** blood, lymph vessels, heart

7x Fxns of Epithelia:

Barriers: Selective permeable

Protection

Secretion

Absorption

Transport

Sensory surface

Regenerate + repair

Classification of Epithelium:

2x types by # of layers

**Unilaminar Epi:** single layer, **simple**

**Multilaminar Epi:** multiple layer: **stratified**

3x types by shape:

**Squamous:** thin, flat “pancakes, fried eggs”

**Cuboidal:** cube

**Columnar:** tall, narrow

4x Simple Epi:

**Simple Squamous Epi:** blood, lymph

**Simple Cuboidal Epi:** glands, ovary, kidney

**Simple Columnar Epi:** GI, gall bladder, repro, resp tracts

**Pseudostratified Columnar Epi:** Nuclei are located at different levels

(tall + short): resp, epididymis, nasal cavity

5x Stratified Epi:

**Stratified Squamous Epi:** 2 types: **Keratinized** + **non-keratinized**

**Keratinized Stratified Squamous Epi:** contain keratin Diagnostic is No nuclei in surface layers Ex) epidermis

**Non-Keratinized Stratified Squamous Epi = Stratified Squamous Mucosal Epi:** Diagnostic is Nuclei in surface cells Ex) wet surface, oral, esophagus, vagina, eye

**Stratified Cuboidal Epi:** has 2 layers of cuboidal shaped cells: sweat, pancreas, salivary glands

**Transitional Epi = UroEpi:** transition btw Stratified Cuboidal + Stratified Squamous: UT,

2x types:

**Non-distended UroEpi:** 5-10 layers, surface cells are cuboidal, tight jxn

**Distended UroEpi: 3**-4 layers, surface are squamous

2x Specialized Epi: has specialized fxns

**1. Sensory Epi:**

3 types:

**Gustatory:** taste buds

**Olfactory:** neuroepi, smell

**Stato-acustic:** inner ear

**2. Germinal Epi**: testis, reproductive cells

2xpolarity of Epi: **Apical + Basolateral**: separated by **Junctional complex**

Apical Domain:

Contains many proteins

Fxn) **endocytosis, exocytosis, transcytosis (across inside one cell)**

4x Apical Surface Membrain Specializations:

(smallest> largest)

**Microvilli:** 1-2 um

**Cilia:** 7-10um

**Stereocilia:** 40-80um

**Flagella:** 100 um

**Microvilli:**

Fxn) fluid absorption, **Non-motile**

Forms **striated, brush border**

Contains:

**25-30 actin filaments**

**Villin:** protein at the top

**Fimbrin:** cross links actin filaments

**Terminal web:** at the base, has actin + spectrin

Location) **GI, kidney**

**Stereocilia:**

Fxn) **Non-Motile**

Same structure as microvilli

Very long

Location) epididymis of testis

**Cilia:**

**Fxn) Motile: move fluid through surface of cells**

**Contains) Axoneme: microtubules**

**Location) Pseudostratified ciliated Epi of resp, attached to basal body**

**Structure of Axoneme:**

**9 + 2 arrangement of microtubules, longitudinally**

**2 singlets: center**

**9 doublets: surrounding**

**Doublet: Subunit A (13 protofilaments) + Subunit B (10 protofilaments)**

2 more structures:

**Sheath: surrounds singlets**

**Radial spoke: projection: subunit A > sheath**

2 more proteins:

**Nexin: connect doublets**

**Dynein: 2 arms project from Subunit A > adjacent Subunit B**

**(24 nm interval along Subunit A)**

**1 important protein:**

**Dynein ATPase:**

**Fxn) Provide energy to bend cilia, cause SubA attach to adjacent Sub B**

**2x strokes: Effector Stroke (bending), Recovery Stroke (returns to upright)**

**\*\*\* Kartagener’s Syndrome = Primary Ciliary Dyskinesia = Immotile Cilia Syndrome**

**Immotile cilia due to lacking dynein cross arms or radial strokes**

**Dx) unable to clear resp tract, lung infection, infertile, malrotation of heart**

**Flagella:** 100 um, similar to cilia, but larger, Mitochondria wrapped around the axoneme

Basolateral Domain:

Lateral domain contains Junctional Complex = Terminal Bars

Location) near apical surface, 2 cell attachment

4x types of Junctional Complex

**Adhesion Belt = Zonula Adherens**

**Desmosome = Macula Adherens**

**Tight Jxn = Zonula Occludens**

**Nexus = Gap Jxn**

1. **Zonula Adherens = Adhesion Belt**

Fxn) mechanical attachement to adjacent cells

Gap is 15-20 nm,

**Cadherin:** transmembrane linker proteins, bind to cell cytoskeleton,

Inside the cell: Dense aggregation of actin filaments include (**vinculin, a-actinin, talin)**

2. **Macula Adherens = Desmosome**

Fxn) deepest, mechanical attachment of cells “spot weld”

Gap is 30 um

**Attachment plaques** = dence web like structure on each cytoplasmic side

Consist of **Desmoplakin + Plakoglobin**

Transmembranes consist of **Cadherins** = **Desmoglein + Desmocolin**

**Intermediate Filaments (IF)** attach to **attachment plaque**

(Disease) **Phemphigus Vulgaris:**

Autoimmune disease

Ab to Cadherin Desmoglein

Desmosomes are destroyed esp in skin

Dx) Blistering, infections

3. **Zonula Occludins = Tight Jxn**

Fxn) most superficial to apical surface

**impermeable barrier,** no materials can pass between cells

Tight Jxn vs. Leaky Jxn (Blood Brain Barrier)

Division btw apical +basolateral membraines, prevent protein movement

Transmembrane Proteins: **Claudin + Occludin**

**Anastomosing Strands** = arrangement “quilted apparence”

**Cadherin** = protein reinforce Anastomosing Strands

4. **Gap Jxn = Nexus**

Fxn) basolateral domain, cell-cell communication

Does Not permit: proteins, Nuc Acids, Polysaccharides

Low E-registance

Gap = 2-3 nm

**Connexons** = disc, aqueous pores in cell membraine

Consists of **6 x Connexin** (subunits of connexons)

3x Basal Domain = “HEB”

**1. Hemidesmosomes** = looks like half of Desmosome (Macula Adherens)

**Integrin =** transmembrane protein

Binds to underlying CT

**2.** **Enfolding = Plasma Membrane Enfoldings**

highly enfolded, tessellated basal membrane, Increase Surface Area

**3. Basal Lamina**

dense layer subadjacent to the basal membrane, in ECM

**Glands:**

* Exocrine vs. Endocrine:

**Exocrine Glands**= form a duct

**Endocrine Glands**= no duct, secrete product (hormones) into the surrounding ECM >> blood

* Unicellular vs. Multicellular:

**Unicellular Glands** = single cells

Ex) Globlet cells in stomach, secretes mucus

**Mucticellular Glands** = numerous cells

Has duct + secretory portion

**Duct** = Simple vs. Compound

**- Simple Exocrine Gland** = single duct

**- Compound Exocrine Gland** = multiple branched duct system

**Secretory:** Tubular vs. Acinar

- **Tubular** = long tube shape

- **Acinar/Alveolar** = grape shape

**Myoepithelial cells** = basket cells surrounding secretory portion

**CT capsule** = surrounds Multicellular glands

**CT Septa** = subdivides gland into lobes + lobules

Ex)

**Simple Tubular** (single duct, long tube secretory portion) Ex) Gastric Glands

**Simple Alveolar** (single duct, grape secretory) Ex) Sebaceous glands of skin

**Simple Branched Alveolar** (single duct, branched grape shape secretory)

Ex) Sebaceous glands

**Simple Coiled Tubular (**single duct, coiled long tube secretory) Ex) Sweat gl

**Compound Tubuloalveolar** (multiple branched duct, long tube and grape shape of secretory portion) Ex) Salivary Glands

* Merocrine vs. Apocrine vs. Holocrine vs. Cytocrine

**Merocrine secretion** = most common mode of secretion

Via Exocytosis, loss of cytoplasm,

Ex) sweat, salivary, pancreas, globlet (stomach)

**Apocrine** secretion = pinching off cells with part of cytoplasm

Ex) Mild of Mammary gland

**Holocrine** secretion = “Horror” cells fills up with secretion, **Dies**

Ex) Sebaceous galnd of skin

**Cytocrine Secretion** = “cells” Whole living cells secreted **Ex) Ovary + Testis**

* Mucus vs. Serous vs. Mixed vs. Sebum vs. Ceruminous

**- Mucous Secretion:** thick viscous secretion, rich in **Mucinogins**

**Ex) globlet cell (stomach), sublingual salivary gland**

**- Serous Secretion: Watery secretion**

**Ex) pancreas, parotid (oral cavity), sweat**

**- Mixed Secretion:** both Mucous + Serous

**Demilunes =** half moon shape on outside of mucus alveolus

Ex) **salivary**

* **Sebum = Oil**

Ex) sebaceous gland of skin, meibomiam gland of eyelid

* **Ceruminous:** Waxy

Ex) Ceruminous glands of external auditory canal